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1 Large meshes and GPU programming: Adaptive tetrapuzzles: efficient out-of-core construction and visualization of gigantic multiresolution polygonal models

Paolo Cignoni, Fabio Ganovelli, Enrico Gobbetti, Fabio Marton, Federico Ponchio, Roberto Scopigno

August 2004 **ACM Transactions on Graphics (TOG)**, Volume 23 Issue 3

Publisher: ACM Press

Full text available: pdf(525.88 KB) mov(23:54 MIN) Additional Information: full citation, abstract, references, index terms

We describe an efficient technique for out-of-core construction and accurate view-dependent visualization of very large surface models. The method uses a regular conformal hierarchy of tetrahedra to spatially partition the model. Each tetrahedral cell contains a precomputed simplified version of the original model, represented using cache coherent indexed strips for fast rendering. The representation is constructed during a fine-to-coarse simplification of the surface contained in diamonds (sets ...

Keywords: Level of Detail, Out-Of-Core Algorithms

2 Bi-scale radiance transfer

Peter-Pike Sloan, Xinguo Liu, Heung-Yeung Shum, John Snyder

July 2003 **ACM Transactions on Graphics (TOG)**, Volume 22 Issue 3

Publisher: ACM Press

Full text available: pdf(7.67 MB) Additional Information: full citation, abstract, references, citings

Radiance transfer represents how generic source lighting is shadowed and scattered by an object to produce view-dependent appearance. We generalize by rendering transfer at two scales. A macro-scale is coarsely sampled over an object's surface, providing global effects like shadows cast from an arm onto a body. A meso-scale is finely sampled over a small patch to provide local texture. Low-order (25D) spherical harmonics represent low-frequency lighting dependence for both scales. To render, a c ...

Keywords: graphics hardware, illumination, monte carlo techniques, rendering, shadow algorithms

3 Translucent patches—dissolving windows

Axel Kramer

November 1994 **Proceedings of the 7th annual ACM symposium on User interface software and technology**
Publisher: ACM Press
Full text available: pdf(1.28 MB) Additional Information: full citation, abstract, references, citings, index terms

This paper presents motivation, design, and algorithms for using and implementing translucent, non-rectangular patches as a substitute for rectangular opaque windows. The underlying metaphor is closer to a mix between the architects yellow paper and the usage of white boards, than to rectangular opaque paper in piles and folders on a desktop.Translucent patches lead to a unified view of windows, sub-windows and selections, and provide a base from which the tight connection betwee ...

Keywords: interaction techniques, interface metaphors, irregular shapes, pen based interfaces, translucency

4 Interactive display of large-scale NURBS models
Subodh Kumar, Dinesh Manocha, Anselmo Lastra
April 1995 **Proceedings of the 1995 symposium on Interactive 3D graphics**
Publisher: ACM Press
Full text available: pdf(3.19 MB) Additional Information: full citation, abstract, references, citings, index terms

We present serial and parallel algorithms for interactive rendering of large scale and complex NURBS models on current graphics systems. The algorithms tessellate the NURBS surfaces into triangles and render them using triangle rendering engines. The main characteristics of the algorithms are improved polygonization algorithms, exploitation of spatial and temporal coherence and back-patch culling. Polygonization anomalies like cracks and angularities are avoided. We analyze a number of issu ...

5 Accelerated walkthrough of large spline models
Subodh Kumar, Dinesh Manocha, Hansong Zhang, Kenneth E. Hoff
April 1997 **Proceedings of the 1997 symposium on Interactive 3D graphics**
Publisher: ACM Press
Full text available: pdf(1.33 MB) Additional Information: full citation, references, citings, index terms

6 Point-based computer graphics
Marc Alexa, Markus Gross, Mark Pauly, Hanspeter Pfister, Marc Stamminger, Matthias Zwicker
August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**
Publisher: ACM Press
Full text available: pdf(8.94 MB) Additional Information: full citation, abstract, citings

This course introduces points as a powerful and versatile graphics primitive. Speakers present their latest concepts for the acquisition, representation, modeling, processing, and rendering of point sampled geometry along with applications and research directions. We describe algorithms and discuss current problems and limitations, covering important aspects of point based graphics.

7 Large models & large displays: GoLD: interactive display of huge colored and textured models
Louis Borgeat, Guy Godin, François Blais, Philippe Massicotte, Christian Lahanier
July 2005 **ACM Transactions on Graphics (TOG)**, Volume 24 Issue 3

Publisher: ACM Press
Full text available: pdf(520.41 KB) Additional Information: full citation, abstract, references, index terms

This paper presents a new technique for fast, view-dependent, real-time visualization of large multiresolution geometric models with color or texture information. This method uses geomorphing to smoothly interpolate between geometric patches composing a hierarchical level-of-detail structure, and to maintain seamless continuity between neighboring patches of the model. It combines the advantages of view-dependent rendering with numerous additional features: the high performance rendering associa ...

Keywords: geomorphing, level-of-detail, multi-resolution geometric modeling, out-of-core rendering, texture mapping, view-dependent rendering, visualization

8 QSplat: a multiresolution point rendering system for large meshes
Szymon Rusinkiewicz, Marc Levoy
July 2000 **Proceedings of the 27th annual conference on Computer graphics and interactive techniques**
Publisher: ACM Press/Addison-Wesley Publishing Co.
Full text available: pdf(3.27 MB) Additional Information: full citation, abstract, references, citings, index terms

Advances in 3D scanning technologies have enabled the practical creation of meshes with hundreds of millions of polygons. Traditional algorithms for display, simplification, and progressive transmission of meshes are impractical for data sets of this size. We describe a system for representing and progressively displaying these meshes that combines a multiresolution hierarchy based on bounding spheres with a rendering system based on points. A single data structure is used for view frustum ...

Keywords: compression algorithms, level of detail algorithms, rendering systems, spatial data structures

9 Reflectance and texture of real-world surfaces
Kristin J. Dana, Bram van Ginneken, Shree K. Nayar, Jan J. Koenderink
January 1999 **ACM Transactions on Graphics (TOG)**, Volume 18 Issue 1
Publisher: ACM Press
Full text available: pdf(6.94 MB) Additional Information: full citation, abstract, references, citings, index terms

In this work, we investigate the visual appearance of real-world surfaces and the dependence of appearance on the geometry of imaging conditions. We discuss a new texture representation called the BTF (bidirectional texture function) which captures the variation in texture with illumination and viewing direction. We present a BTF database with image textures from over 60 different samples, each observed with over 200 different combinations of viewing and illumination directions. We describe ...

10 Real-time hatching
Emil Praun, Hugues Hoppe, Matthew Webb, Adam Finkelstein
August 2001 **Proceedings of the 28th annual conference on Computer graphics and interactive techniques**
Publisher: ACM Press
Full text available: pdf(6.06 MB) Additional Information: full citation, abstract, references, citings, index terms

Drawing surfaces using hatching strokes simultaneously conveys material, tone, and form. We present a real-time system for non-photorealistic rendering of hatching strokes over arbitrary surfaces. During an automatic preprocess, we construct a sequence of

mipmapped hatch images corresponding to different tones, collectively called a *tonal art map*. Strokes within the hatch images are scaled to attain appropriate stroke size and density at all resolutions, and are organized to maintain c ...

Keywords: chicken-and-egg problem, line art, multitexturing, non-photorealistic rendering

11 Hardware rendering: RPU: a programmable ray processing unit for realtime ray tracing

Sven Woop, Jörg Schmittler, Philipp Slusallek
July 2005 **ACM Transactions on Graphics (TOG)**, Volume 24 Issue 3
Publisher: ACM Press
Full text available: pdf(673.25 KB) Additional Information: full citation, abstract, references, index terms

Recursive ray tracing is a simple yet powerful and general approach for accurately computing global light transport and rendering high quality images. While recent algorithmic improvements and optimized parallel software implementations have increased ray tracing performance to realtime levels, no compact and programmable hardware solution has been available yet.This paper describes the architecture and a prototype implementation of a single chip, fully programmable Ray Processing Unit (RPU). It ...

Keywords: hardware architecture, programmable shading, ray processing unit, ray tracing

12 An updated cross-indexed guide to the ray-tracing literature

L. Richard Speer
January 1992 **ACM SIGGRAPH Computer Graphics**, Volume 26 Issue 1
Publisher: ACM Press
Full text available: pdf(2.94 MB) Additional Information: full citation, index terms

13 Real-time shading

Marc Olano, Kurt Akeley, John C. Hart, Wolfgang Heidrich, Michael McCool, Jason L. Mitchell, Randi Rost
August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**
Publisher: ACM Press
Full text available: pdf(7.39 MB) Additional Information: full citation, abstract

Real-time procedural shading was once seen as a distant dream. When the first version of this course was offered four years ago, real-time shading was possible, but only with one-of-a-kind hardware or by combining the effects of tens to hundreds of rendering passes. Today, almost every new computer comes with graphics hardware capable of interactively executing shaders of thousands to tens of thousands of instructions. This course has been redesigned to address today's real-time shading capabili ...

14 Monte Carlo techniques for direct lighting calculations

Peter Shirley, Changyaw Wang, Kurt Zimmerman
January 1996 **ACM Transactions on Graphics (TOG)**, Volume 15 Issue 1
Publisher: ACM Press
Full text available: pdf(9.20 MB) Additional Information: full citation, abstract, references, citings, index terms, review

In a distributed ray tracer, the sampling strategy is the crucial part of the direct lighting calculation. Monte Carlo integration with importance sampling is used to carry out this calculation. Importance sampling involves the design of integrand-specific probability density functions that are used to generate sample points for the numerical quadrature. Probability density functions are presented that aid in the direct lighting calculation from luminaires of various simple shapes. A method ...

Keywords: Monte Carlo integration, direct lighting, importance sampling, luminaires, ray tracing, realistic image synthesis

15 Session 5: simplification and meshes: Budget sampling of parametric surface patches

Jatin Chhugani, Subodh Kumar

April 2003 **Proceedings of the 2003 symposium on Interactive 3D graphics**

Publisher: ACM Press

Full text available: pdf(1.73 MB) Additional Information: full citation, abstract, references

We investigate choosing point samples on a model comprising parametric patches to meet a user specified budget. These samples may then be triangulated, rendered as points or ray-traced. The main idea is to pre-compute a set of samples on the surface and at the rendering time, use a subset that meets the total budget while reducing the screen-space error across the model. We have used this algorithm for interactive display of large spline models on low-end graphics workstations. This is done by d ...

Keywords: adaptive tessellation, point sampling, spline surfaces

16 Image-based reconstruction of spatial appearance and geometric detail

Hendrik P. A. Lensch, Jan Kautz, Michael Goesele, Wolfgang Heidrich, Hans-Peter Seidel

April 2003 **ACM Transactions on Graphics (TOG)**, Volume 22 Issue 2

Publisher: ACM Press

Full text available: pdf(302.22 KB) Additional Information: full citation, abstract, references, citings, index terms

Real-world objects are usually composed of a number of different materials that often show subtle changes even within a single material. Photorealistic rendering of such objects requires accurate measurements of the reflection properties of each material, as well as the spatially varying effects. We present an image-based measuring method that robustly detects the different materials of real objects and fits an average bidirectional reflectance distribution function (BRDF) to each of them. In or ...

Keywords: BRDF measurement, normal map acquisition, photometric stereo, shape from shading, spatially varying BRDFs

17 Meshes & surfaces: Adaptive sampling of intersectable models exploiting image and object-space coherence

Anders Adamson, Marc Alexa, Andrew Nealen

April 2005 **Proceedings of the 2005 symposium on Interactive 3D graphics and games**

Publisher: ACM Press

Full text available: pdf(6.01 MB) Additional Information: full citation, abstract, references, index terms

We present a sampling strategy and rendering framework for intersectable models, whose surface is implicitly defined by a black box intersection test that provides the location and normal of the closest intersection of a ray with the surface. To speed up image generation

despite potentially slow intersection tests, our method exploits spatial coherence by adjusting the sampling resolution in image space to the surface variation in object space. The result is a set of small, view-dependent biline ...

Keywords: adaptive sampling, object-space coherence

18 Global illumination: Global illumination animation with random radiance representation

László Szirmay-Kalos, György Antal, Balázs Benedek

June 2003 **Proceedings of the 14th Eurographics workshop on Rendering EGRW '03**

Publisher: Eurographics Association

Full text available: pdf(1.27 MB) Additional Information: full citation, abstract, references

This paper proposes a non-diffuse global illumination algorithm that is fast enough to be appropriate for interactive walkthroughs and general animations. To meet the servere performance requirements, we heavily exploit coherence both in time and space, and use randomization to reduce the time and storage complexity. To speed up convergence and to support animation, the approximation of the radiance is stored in object space as well. However, in order to reduce the high memory requirements of su ...

Keywords: Monte-Carlo methods, animation, finite-element techniques, global illumination, stochastic iteration, walkthrough

19 Rendering equation revisited: how to avoid explicit visibility computations

Marco Pellegrini

January 1999 **Proceedings of the tenth annual ACM-SIAM symposium on Discrete algorithms**

Publisher: Society for Industrial and Applied Mathematics

Full text available: pdf(1.06 MB) Additional Information: full citation, references, citings, index terms

20 Texturing techniques for terrain visualization

Jürgen Döllner, Konstantin Baumman, Klaus Hinrichs

October 2000 **Proceedings of the conference on Visualization '00**

Publisher: IEEE Computer Society Press

Full text available: pdf(3.71 MB) Additional Information: full citation, citings, index terms

Keywords: 3D maps, level of detail, multiresolution, terrain rendering, texture mapping

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